Silicon Power Supply

Introduction

This supply was designed to power the Silicon tracker detector of the Dzero Colliding Detector. Power Supply must provide precise voltages for silicon vertex readout (SVX) asic, and interface controls. Each supply will need to power as many as 152 HDI strings.

The Silicon supply will provide ten separate voltages to power the Silicon circuits. A commercial modular power supply manufactured by Vicor / Westcor was chosen as the main power component for this application. This power will be supplied through a motherboard.

General Description

The primary consideration for the new Silicon power supply design is to use existing designs as much as possible. The main changes will be to add two extra channels to the existing motherboard and add remote sensing to all supplies

In order to accomplish this two new shunt circuits and a daughter board will have to be added to implement controls, trips and status readings. An additional indicator/voltage adjust board will have to be added to the front panel.

The power requirements are 1350 Watts delivered. In order to meet this power requirement a switching type supply will have to be utilized.

Environment and Construction Considerations

The presence of a magnetic field further complicates supply construction. Although the field is not considerably high, 200-300 gauss, its volume is very large (over 6 m x 6 m x 6 m). The supply volume 10-1/2" x 10-1/2" x 18" makes shielding somewhat difficult. The supplies will be built around a commercial Vicor MegaPAC that will operate from the present 20Amp 208VAC source.

Testing has shown that these supplies fail when operated in a field of more than 175 gauss with the orientated in the vertical direction. To reduce the field to an adequate level, a two part shielding scheme will be utilized.

The first level for shielding is in the form of a ¼" thick hot rolled steel box. This provides the main reduction of the magnetic field to a manageable level and is the main chassis that houses the supply module.

The second level of field reduction is a smaller magnetic shield, which surrounds the Vicor supply. This two-part shield is directly enclosing the Vicor chassis.

Since the supply will be enclosed in a steel chassis cooling is required. Cooling water will be used on heat producing objects inside the box. Each Vicor module is fitted with a copper tube for cooling.

Monitoring and Control Description

Monitoring will be implemented so the voltage and current can be monitored via a computer connection. In addition if any voltage or current exceeds a set level all output voltages will be disabled. This is done to prevent the application of partial power to the silicon circuits. The supplies have fuses(20amp) on the primary 208VAC input and a solid state 3-phase relay to control applying main power to the Vicor supply. There will be a local On/Off, Reset and Local/Remote switch on the front panel. There are LED indicators for local information.

The Vicor supplies have built-in analog temperature sensing that are used for monitoring. This signal is 2.5V/25? C and has a range of 0-100? C. There are signals for Phase Fault, Over Temperature Warning and AC Power OK that will be inputs to the logic control circuitry.

- The Phase Fault signal, which is active high, drops low when the input reaches the over current level of 30 Amps due to a missing phase or severe line imbalance.
- The AC Power OK signal, active high, will drop low about 3ms before the output regulation is lost. An AC Power Fail signal is the compliment of the AC Power OK.
- The Over Temperature Warning signal, normally high, drops low somewhere between 65-76? C. The recovery point is 1? C below the actual trip point. This is built-in protection that activates when the inlet temperature exceeds 70-81? C. Recovery is 10? C below the actual trip level. This signal is directly ANDed with the External Interlock signal and controls the 208 AC input by operating the solid state relay.

There will be two conditions that will turn the supply off in the event of a fault condition. The first condition occurs when a monitored supply exceeds a preset level for more than 8 milliseconds. This can be considered a normal fault condition. This type of fault only inhibits the outputs of the Vicor and latches the fault until cleared.

The second condition occurs when a silicon cooling interlock, an External Interlock, phase fault or temperature warning from the Vicor is false. The main 208 AC power to the supply will be removed when this occurs. The thought here is that a more serious fault or problem has happened and more direct measures should be taken. This might be caused by a direct failure of a module which fails to respond to a normal inhibit signal or smoke or water was detected.

A third and final level of protection will be in-line fuses on each output from the supply. This will ensure that wire currents will not exceed a safe level. The fusing will be above the normal operating levels and should not open under a normal fault condition.

Logic control will be implemented with a programmable logic gate array. This provides the best flexibility and size reduction for the power supply system.

Control power (+5V and +15V) will be a separate supply that will be ON whenever the AC is applied to the box. This small supply has a line fuse.

An additional temperature sensor will be instrumented to reflect the plate temperature for the current sensing shunts.

A hall probe will provide magnetic field information inside the steel shell.

Power Supply Specification

Slot	Supply Type	Supply Voltage(volts)	Supply Current(amps)	Supply Power(watts)	Board. Fuse Amp.
1	VCC#1	6.3	30.8	194.04	**30**
2	VCC#2	6.3	30.8	194.04	**30**
3	VCC#3	6.3	30.8	194.04	**30**
4	DVDD#1	5.5	4.3	23.65	**30**
5	DVDD#2	6	23.1	138.6	**30**
6	AVDD2	4	20	80	**30**
7	AVDD#1	5.5	4.3	23.65	**30**
8	AVDD#2	6.4	30.8	197.12	**30**
9	AVDD#3	6.6	30.3	199.98	**30**
10	15VDC	15.5	6.5	100.75	**30**
				1345.87	

Slot	Power Supply Type	Fuse Panel Amp.	Voltage @ Fuse Panel Volts	Voltage Trip Volts	Current Trip Volts(Amps)
1	VCC#1	7	**5.24**	**7.00**	**9.90** (**29.70**)
2	VCC#2	7	**5.24**	**7.00**	**9.90** (24.75)
3	VCC#3	7	**5.24**	**7.00**	**9.90** (24.75)
4	DVDD#1	**2**	**5.10**	**6.80**	**1.60** (4.00)
5	DVDD#2	5	**5.35**	**6.50**	**8.00** (20.00)
6	AVDD2	5	**4.00**	**4.90**	**8.00** (20.00)
7	AVDD#1	**2**	**5.45**	**6.80**	**1.60** (4.00)
8	AVDD#2	5	**5.75**	**7.00**	**9.90** (24.75)
9	AVDD#3	5	**6.00**	**7.20**	**9.90** (24.75)
10	15VDC	2	**15.00**	**8.00**	**2.40** (6.00)